UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
09/023,146	02/12/98	SANDHU G	3369US(91-36

MM91/0512

JOSEPH A WALKOWSKI
TRASK BRITT & ROSSA
PO BOX 2550
SALT LAKE CITY UT 84110

EXAMINER	
DANG, T	
ART UNIT	**PAPER NUMBER**
2823	

DATE MAILED: 05/12/00

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary	Application No. 09/023,146	Applicant(s) Sandhu
	Examiner Trung Dang	Group Art Unit 2823

☒ Responsive to communication(s) filed on *Mar 28, 2000*.

☐ This action is **FINAL.**

☐ Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire *three* month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claims

☒ Claim(s) *1-47* is/are pending in the application.

Of the above, claim(s) _____ is/are withdrawn from consideration.

☐ Claim(s) _____ is/are allowed.

☒ Claim(s) *1-47* is/are rejected.

☐ Claim(s) _____ is/are objected to.

☐ Claims _____ are subject to restriction or election requirement.

Application Papers

☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on _____ is ☐approved ☐disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☐ None of the CERTIFIED copies of the priority documents have been

☐ received.

☐ received in Application No. (Series Code/Serial Number) _____.

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____.

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

☐ Notice of References Cited, PTO-892

☐ Information Disclosure Statement(s), PTO-1449, Paper No(s). _____

☐ Interview Summary, PTO-413

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

--- SEE OFFICE ACTION ON THE FOLLOWING PAGES ---

1. Claims 1-47 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

The rejection is maintained as of record and is repeated herein.

The instant application discloses a method for depositing tungsten silicide films characterized by the formula WSi_x. However, without defining or specifying numerical values of x, one cannot determine the final product so that the invention can be practiced. Would it be WSi, $WSi_{1.2}$, $WSi_{1.5}$, WSi_2, or any amount of Si in the tungsten silicide film? The specification, therefore, does not contain a written description of the invention in a full, clear, and concise manner as required by the first paragraph of 35 U.S.C § 112.

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The rejection is maintained as of record and is repeated herein.

Claims 1, 2, 4, 5, 8, 9, 12-19, and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kawanishi et al. (English translation of JP-39528, cited by applicant) taken with Price et al.

Kawanishi teaches a process for depositing a tungsten silicide film on a substrate which comprises the steps of: forming a nucleation layer of tungsten silicide (WSi_2) on the substrate using a CVD process with silane (SiH_4) silicon source gas and a reactant gas of tungsten hexafluoride (WF_6) at a temperature of 360°C; depositing a WSi_2 film on the nucleation layer by CVD using dichlorosilane (SiH_2Cl_2) silicon source gas and WF_6 reactant gas at a temperature of 680°C. See pages 6-7.

The difference between Kawanishi and the claims is in the deposition temperature of which the WSi_2 film is deposited using SiH_2Cl_2 and WF_6.

However, Price et al. teaches that once a nucleation layer of tungsten disilicide was formed by initiating a plasma discharge in a short time, tungsten disilicide (WSi_2) can be deposited by CVD from a mixture of SiH_2Cl_2 and WF_6 at a temperature in a range of 390-400°C without the presence of plasma. See col. 6, lines 53-54 in conjunction with col. 5, lines 54-68; col. 9, lines 1-12, and Fig. 6.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Kawanishi's teachings by depositing the WSi_2 film on the nucleation layer at a temperature in a range of 390-400°C because of the followings:

a) It is known that once a temperature above the dissociation temperature of reactive gases (critical temperature Tc) is reached, the deposition rate varies

gradually with temperature change hence the control of temperature is not critical for film thickness control so long as a minimum deposition temperature is exceeded. See Price col. 5, lines 66-68; col. 6, lines 20-27. Thus, one skill in the art would find it obvious to deposit the WSi_2 film of Kawanishi at the temperature range suggested by Price because lower temperature deposition would be beneficial in that thermal budget is reduced while assuring substantially the same deposition characteristics (e.g. temperature/deposition rate independency, film thickness uniformity) as the film is deposited at 680°C.

b) It is known, as shown in Price that once a nucleation layer of tungsten disilicide was formed by initiating a plasma discharge in a short time, a WSi_2 film can be deposited in a range of 390-400°C with a rapid deposition rate and a good uniformity without the presence of plasma (col. 9, lines 1-20). Thus, it would have been obvious that, in the process of Kawanishi, once a nucleation layer has been formed, a WSi_2 film can be deposited at a temperature range of 390-400°C as suggested by Price because the application of an old process to make the same would have been within the level of an artisan.

As for claim 14, the Examiner takes official notice that Argon, Nitrogen, or Helium is known individually as a carrier gas. Since each member of the claimed mixture is known individually as a carrier gas, one of ordinary skill in the art would expect such mixture to function as a carrier gas in an additive or cumulative manner.

As for claims 13 and 15, the selection of deposition time and flow rates of reactive gases is not inventive since it has been held that discovery an optimum

value of a result effective variable involves only routine skilled in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

As for claims 16 and 17, the combined rejection meets the claimed limitation in that 360°C is considered substantially equivalent to 390°C.

3. Claims 3, 6, 7, 10, 11, 20, 22, and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kawanishi taken with Price as applied to claims 1, 2, 4, 5, 8, 9, 12-19, 21 above, and further in view of Brors et al. (U.S. Pat. 4,565,157 cited by applicant).

The rejection is maintained as of record and is repeated herein.

The combination of Kawanishi and Price teaches a process as noted above with the exception that the references do not specifically mention that the WSi2 film is deposited using a cold wall CVD system as claimed, although Kawanishi does suggest that any existing CVD apparatus can be used with the same effect (page 11, lines 13-15).

Brors teaches that deposition of WSi_2 using a cold wall CVD system with premix chambers is advantageous over conventional hot wall CVD system in that a deposited film with high quality and uniformity can be obtained. See line 53 of col. 2 to line 32 of col. 3; col. 4, lines 45-68; col. 7, lines 1-40.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have deposited the WSi_2 film using the cold wall CVD system as suggested by Brors because doing such would obtain a film with high quality and uniformity.

As for claims 6 and 22, the Examiner takes official notice that a carrier gas is conventionally used in the deposition of tungsten silicide. Also see col. 4, lines 45-50 in Brors for the mixing of a silicon source gas, a reactant gas, and a carrier gas in a mixing chamber 28.

As for claims 7 and 23, the selection of a flow rate as claimed is not inventive since it has been held that discovery an optimum value of a result effective variable involves only routine skilled in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

4. Applicant's arguments filed 3/6/2000 (paper No. 10) have been fully considered but they are not persuasive.

With respect to the 112, first paragraph rejection, applicant argues that the specification at least define one formation of WSi_x as WSi_2 , which is recited at col.1, lines 15-18. However, that part of the disclosure discusses the tungsten silicide (WSi_2) of prior art , not part of the instant invention. Nowhere in the part of the specification that pertains to the instant invention (starting from the Summary Of The Invention section) has applicant clearly defined WSi_x has at least one formula WSi_2 as alleged. Applicant further argues that one having ordinary skill in the art of tungsten silicide deposition process would understand the chemical formula WSi_x to encompasses all forms of tungsten silicides. The Examiner disagrees for the following reasons:

a) An enabling disclosure under 35 USC 112, first paragraph, is one which allows those skilled in the art to make and use the claimed invention without undue

experimentation. Ex parte Singh 17 USPQ 2d 1714, 1715 (BPAI 1990); In re Wands 8 USPQ 2d 1400 (Fed. Cir. 1988); U. S. V. Telectronics Inc. 8 USPQ 2d 1217 (Fed. Cir. 1988). The desired stoichiometry of a tungsten silicide film having a general formula WSi_x is known to depend largely on the deposition conditions such as active gases flow rates, deposition temperature, etc., and the resulted silicide film possesses different electrical characteristic. Two references cited in the parent case SN 08/506952 make it evident that the deposition of WSi_x where x is between 2.0 and 4.0 (see Brors, U.S. Pat. 4,851,295) and where x is between 0.01 and 0.1 (see Ohba, U.S. Pat. 4,902,645) requires totally different deposition conditions. Thus, in order to form a WSi_x which encompasses all forms of tungsten silicide, one having ordinary skill in the art would necessarily perform tremendous undue experimentations.

b) If applicant was allowed the protection of all form of tungsten silicide, this would prevent others from obtaining a new and useful composition of tungsten silicide.

Applicant also points out that the specification (col.3, line 62 to col. 4, line 9) provides details of deposition conditions which produces one form of WSi_x, hence it is not necessarily required "undue experimentation" to carry out the instant invention. This argument is unconvincing because, as acknowledged by applicant, the disclosed deposition conditions results in only one form of WSi_x, i.e., one particular value of x is obtained. To obtain unlimited values of x covered by the formula WSi_x obviously requires undue experimentation.

With respect to the 103 rejection over Kawanishi taken with Price, applicant argues that Kawanishi expressly teaches that low treatment temperature formation of the metal silicides is undesirable, i.e., Kawanishi teaches away from the present invention (Remarks, first full paragraph of page 7). The Examiner disagrees. The portion in Kawanishi that applicant referred to is directed to Kawanishi's discussion of problems of prior art when WSi_2 is deposited by a single deposition step at low temperature. One of such prior art problem is the poor adhesion and poor step coverage. Accordingly, Kawanishi solves the aforementioned problem by employing a two step deposition in forming the WSi_2. The first step is to form a WSi_2 nucleation layer at 360°C, and the second step is to form a WSi_2 on said nucleation layer at 680°C. Thus, Kawanishi does not teach away from the present invention since Kawanashi's process involves two step deposition, not the one step, low-temperature deposition which is undesirable. Moreover, Kawanishi's second step deposition does not limit to 680°C. It is the second step deposition where Price's teaching provides motivation to deposit the WSi_2 film at low temperature for the advantages noted in the rejection.

As for Price's reference, applicant argues that "the teaching of the one-step deposition process which requires plasma deposition in Price et al. would not lead one of ordinary skill in the art to combine the low-temperature deposition of Price et al. with any other art in the absence of the required plasma deposition". The Examiner disagrees. Price reference was used a secondary reference provides the teaching that a tungsten silicide film can be deposited at a temperature range of 390-400°C without plasma, once a nucleation layer has been preformed. Applying

Price's teaching to the process of Kawanishi with motivation as recited in the rejection which results in a combined process which does not include the plasma ignition step.

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Trung Dang whose telephone number is (703) 308-2548. The examiner can normally be reached on weekdays from 8:30AM to 5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy, can be reached on (703) 308-4918. The fax phone number for this Group is (703) 305-3432 or (703) 308-7725.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.

Trung Dang
Primary Examiner

Dang/ds
04/13/00